

ATOMIC MODELS AND COMPONENTS OF THE ATOM



Unit Introduction

In this unit you will learn all about the atom. First, explore the history of atomic models and contributions of various scientists. Then, learn about the components of atoms.

Models of the Atom


In science, the smallest particle that can exist and still have the properties of the element is called an *atom*. Science has developed many models throughout our scientific history to describe or illustrate the makeup of an atom. Over time, technology has allowed scientists to discover more details about the structure of atoms.

The following website is very helpful in understanding the timeline of various atomic models of the past and present:

<https://www.texasgateway.org/sites/default/files/resources/documents/EvolutionOfAtomicModel.pdf>

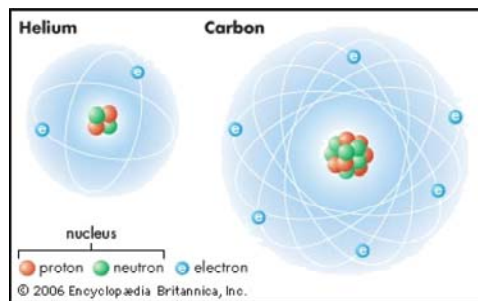
Use this table to take notes and summarize the history of atomic models:

[SUDENT COPY OF ATOM DOCUMENT](#)

Scientist	Time	Background	Summary	Image of Model
Democritus	470-380 BC	Greek philosopher; known as the father of modern atomic thought	matter is made of small particles called "atomos" that cannot be broken down any further	
Dalton				
Thomson				
Rutherford				
Bohr				
Chadwick				
Modern				

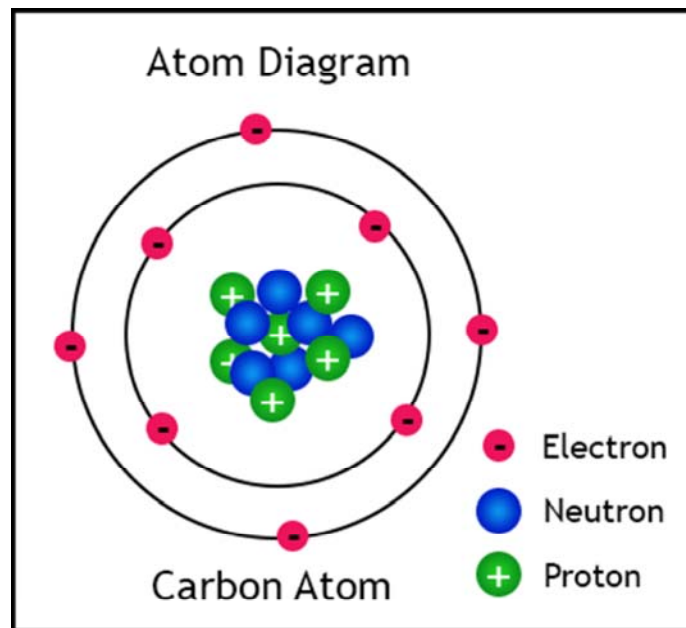
The currently popular atomic model is called the electron cloud model. In the case of the atom, models are being used to describe or illustrate something that is too small to see. We cannot see an atom and its components with the naked eye, so a model allows us to conceptually grasp what an atom looks like.

Atomic models of helium and carbon:



Atomic Components

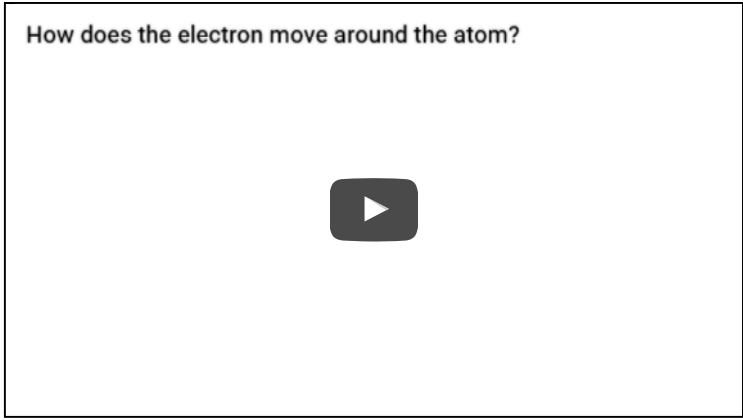
Atoms are very tiny particles that consist mostly of empty space. Atoms are made of even smaller components, known collectively as subatomic particles. There are three main subatomic particles, known as protons, electrons, and neutrons. **Protons** have a positive charge and they are found in the nucleus. **Neutrons** have a neutral charge and they are also found in the nucleus. Since the nucleus has particles of neutral and positive charges, the overall charge of the nucleus is positive. Atoms are electrically neutral overall, which means that there needs to be an area of negativity to balance out the positive nucleus. That negativity is found in electrons. **Electrons** have a negative charge and they orbit around the outside of the nucleus.



Watch the following video clip to learn more about the atom and its components:

 The Atom (4:18)

This video clip shows an interesting perspective on how electrons move about inside the atom:



Atomic Mass

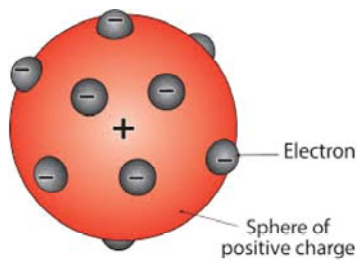
Protons and neutrons contribute to the mass of the atom, but the mass of electrons is negligible since they are so tiny. One proton has a mass of one atomic mass unit, or 1 AMU. One neutron also has a mass of 1 AMU. The mass of electrons is not considered when calculating the total mass of the atom.

What makes an atom of one element different from an atom of another element is the number of protons in its nucleus, or its *atomic number*. The number of protons plus the number of neutrons in its nucleus is known as its *atomic mass*. When you look at the periodic table, such as the one below, the atomic number is at the top and the atomic mass is indicated for each element at the bottom of the square.

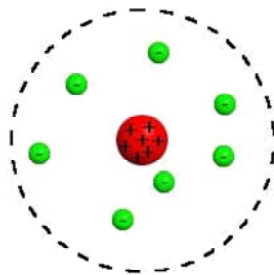
1 H Hydrogen 1.008																	2 He Helium 4.003	
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948	
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.630	33 As Arsenic 74.922	34 Se Selenium 78.972	35 Br Bromine 79.904	36 Kr Krypton 83.798	
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 97	44 Ru Ruthenium 101.07	45 Rh Rhodium 101.06	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.905	54 Xe Xenon 131.29	
55 Cs Cesium 132.905	56 Ba Barium 137.327	* 57-70 Lanthanide series	71 Lu Lutetium 174.967	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	** 89-102 Actinide series	103 Lr Lawrencium 260	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 263	107 Bh Bohrium 264	108 Hs Hassium 265	109 Mt Meitnerium 266	110 Ds Darmstadtium 267	111 Rg Roentgenium 268	112 Cn Copernicium 269	113 Nh Nihonium 270	114 Fl Flerovium 271	115 Mc Moscovium 272	116 Lv Livermorium 273	117 Ts Tennessine 274	118 Og Oganesson 276
57 La Lanthanum 138.905	58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.054					
89 Ac Actinium 227	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259					

Rutherford's Experiment

What we know about the structure of the atom and the charged particles is due in large part to Ernest Rutherford's gold foil experiment. Previously to his studies, the widely accepted atomic model was Thomson's raisin bun model, which hypothesized a positively charged solid atom with negatively charged particles dispersed throughout the atom. The raisin bun model Thomson developed looked like this:



Rutherford wanted to expand knowledge of the atom, so he proposed that blasting alpha particles through a thin sheet of gold foil would cause the particles to penetrate the foil or possibly be deflected off to the side. What he found is that every once in a while, particles bounced back. This led to his discovery of a tiny, but massive, positively charged nucleus in the center of the atom, as well as negatively charged electrons that circle the nucleus in empty space surrounding the nucleus. His nuclear model of the atom looked like this:



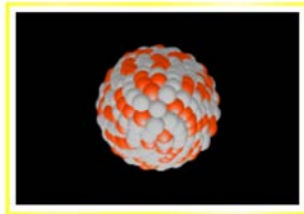
The following video clip will help to expand your knowledge and understanding of Rutherford's gold foil experiment. As you watch, create an annotated diagram that shows the experiment with the information that Rutherford discovered by completing the experiment. Scan or photograph your diagram and submit your work for question #13 in the assessment portion of the unit.

Rutherford's gold foil experiment | Electronic structure of atoms | Chemistry | Khan Academy



PhET Simulation: Rutherford Scattering

Now, imagine that you are conducting Rutherford's gold foil experiment. Go to the following website to interact with the simulation. Complete the attached document and submit your work for question #14 in the assessment portion of the unit.



Rutherford Atom



Plum Pudding Atom

PHET

[STUDENT PHET SIMULATION DOCUMENT](#)

Quizlet Vocabulary

https://quizlet.com/_3b27sl



Now answer questions 1 through 14.